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NPIC/TDS/D-763-67
20 March 1967

MEMORANDUM FOR: Chief, Exploitation Systems Branch, DS

25X1 SUBJECT : [redacted] Rear Projection Viewer Project

REFERENCES : (A) Memorandum, NPIC/TDS/D-741-67, Entitled Contract Negotiations with [redacted] Dated 10 March 1967 (B) [redacted] Letter Dated 15 March 1967

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1. Reference A described an unsuccessful contract negotiation with [redacted] and outlined the options that [redacted] was expected to offer; Reference B outlines the compromises they did offer.

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2. The basic options are the following:

a. A one element zoom system ocvering the entire range 3X to 70X for [redacted]

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b. A two element zoom system for [redacted]

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3. The one element zoom system offers some attractive features; however, because of the large compromise in the optical performance, it is recommended that the additional funds [redacted] be appropriated to cover the rate changes as outlined in reference (A) to construct the two element system.

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4. Because the optical quality of rear projection viewers has always been their limitation in the past, it should not be compromised in this viewer since the concept of the rear projection viewing will be under evaluation upon the completion of this development. The one element zoom system has a very bad off axis image quality; specifically a degradation of up to 89% of the on axis resolving power (the specification for the two element zoom system is off axis degradation of no more than 20%).

5. With the basic viewer designed for the two element system, a retrofit would be possible for production versions if [redacted] later developes a higher performance one element system; however, if the project is initiated with the one element system and it proves unsatisfactory, a large portion of the viewer would have to be completely redesigned for a retrofit for the two element zoom system.

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Declass Review by NGA.

Group 1
Excluded from automatic downgrading and declassification

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SUBJECT: [redacted] Rear Projection Viewer Project

6. It is recommended that the attached technical specification document be incorporated into the contract.

7. It is additionally recommended that action be taken on this project before rate changes again effect the funding allocation required.

[redacted]

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ESB

Attachment: As stated

Distribution:
Orig & 1 - Addressee
2 - Ch/ESB

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Attachment to TDS/D-763-67
20 March 1967

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PERFORMANCE SPECIFICATIONS
[redacted] REAR-PROJECTION VIEWER NOD 110

1. INTRODUCTION:

These performance specifications describe requirements to be met in the fabrication of an advanced rear-projection viewer.

One of the best methods of rapidly scanning large volumes of film is through the use of rear-projection viewers; however, these viewers have been a limiting factor in the amount of information that is available to the photo interpreter. The result of this development will be an instrument that will increase the information transfer between the photograph and the photo interpreter.

2. CONCEPT:

2.1. Purpose - This development will allow the photo interpreter to obtain more information than is now possible with existing rear-projection viewers and will also provide more flexibility in the overall scanning operation.

2.2. Scope - The scope of this development will be the design and fabrication of an operational, prototype, advanced rear-projection viewer.

3. REQUIREMENTS:

3.1. General Configuration -

3.1.1. Overall width of any one section of the viewer shall not exceed 34 1/2 inches (with all panels collapsed), which will facilitate movement through a 36 inch office door. The overall height shall not exceed 75 inches. The depth shall be no greater than 86 inches. Maximum time for preparing the instrument for movement through doors shall not exceed 15 minutes.

3.1.2. The center of the viewing screen shall be 53.5 inches from the floor.

3.1.3. The viewer will be configured to allow two or more interpreters to view the screen at the same time.

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3.2. Optical System -

3.2.1. Quality -

3.2.1.1. The prime objective of this development is to produce a practical viewer having the optical quality exhibited in Figure 1. The resolution requirements are 10 lp/mm/magnification power @ 3X decreasing linearly to 6 lp/mm/magnification power @ 70X using a high contrast resolution target. These values are to be read on the viewing side of the screen and should not vary more than 20% over the entire screen. The resolution acceptance test is to be performed at the final destination with a high contrast resolution target.

3.2.1.2. The optical system is to be so designed that when the image is in sharp focus there will be no apparent color fringing on the screen when the screen is inspected with a 10X magnifier when a calibrated grid is projected; geometric distortion of the images at the screen shall not exceed two percent.

3.2.2. Magnification - The system shall provide a minimum magnification of 3X and a maximum of 70X. If two ranges are used, they must be par focused so that when changed, the images will remain in focus.

3.2.3. Screen -

3.2.3.1. The size of the screen shall be 30 inches square.

3.2.3.2. The most efficient screen which provides uniform luminance over a large solid angle (90°), shall be used. The screen should reproduce or transmit an image with minimum color contribution and granularity. The degradation of contrast should be kept to a minimum.

3.2.4. Illumination -

3.2.4.1. Brightness - The screen brightness, as viewed from the position of the observer, will have a minimum acceptable luminance of 20 ft. lamberts (1 ft. lambert = 1 Pie candles per square foot). This luminance will be measured with a film of neutral density (1.5) filling the film plane. The screen will be evenly illuminated and at no point will the illumination deviate by more than 10%. It is required that the light intensity be continuously variable from 100% to 50% of the above values. The color temperature of this illumination shall never fall below 3400° K. The brightness of the original light source will not diminish by more than 10% during the first 1000 hours of operation.

3.2.4.2. Cooling - The light source shall be positioned in the optimum burning position as specified by the manufacturer. Adequate cooling of the source shall be provided to minimize premature burnout and other glass breakage due to heat. Maximum acceptable film temperature in the film gate is 100°F when used in an ambient room temperature of 80° or below. Temperature tests will be made with silver halide film, in a static state, with a fogged density of 1.5, completely filling the entire gate, with the light source burning continuously at maximum brightness for three hours.

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3.2.5. Focus - The instrument will maintain maximum film flatness in both static and dynamic modes. In the static condition, the entire projected image will remain in sharp focus regardless of magnification. The instrument will automatically compensate for any focus change when the film is transported. The projected image shall remain in sharp focus at all points on the screen; any focus compensation required shall be faster than the normal perception of the human eye.

3.2.6. Image Rotation - Image rotation through 360° shall be provided. This should be easily controlled from the instrument panel.

3.3. Film Transport System-

3.3.1. Film transport shall be provided to accommodate various widths of roll film ranging from 1000 foot rolls of 70mm to 500 foot rolls of 9 1/2" material of standard film thickness. However, the transport should be so designed to permit use of thin base material. A wide variety of film spools may be used; however, they shall generally conform to Air Force specifications. The viewer should accommodate any size between 70mm and 9.5 inches, inclusive.

3.3.1.1. Film width tolerances (slit widths), (as furnished by the Eastman Kodak Company) are as follows:

For serial films, the widths and tolerances are in accordance with American Standard PH 1.10, 1952 and Military Specifications MIL-F-32B, 3 June 1958. These are as follows:

| Nominal Widths | Width Aims (In.) | Tolerances (In.) |
|---|---|---|
| 70mm | 2.754 | ±0.002 |
| 5 inch | 4.960 | ±0.010 |
| 7 inch | 6.991 | +0.010 - 0.005 |
| 9 1/2 inch | 9.460 | +0.010 - 0.005 |

Two sizes are not covered by American Standard nor the Military Specification. Current size and tolerances are as follows:

| Nominal Widths | Width Aims (In.) | Tolerances (In.) |
|---|---|---|
| 6.6 inch | 6.600 | 0.010 - 0.005 |
| 8.0 inch | 7.960 | 0.010 - 0.005 |

3.3.1.2. Design of the transport shall insure safe handling of film, both standard and thin base, at all speed, i.e., no stretching, tearing, frilling edges, scratching, etc.

3.3.1.3. Three film drive speed ranges are to be provided.

3.3.1.3.1. High speed rapid advance/rewind. The maximum speed will be dictated by safe film handling practices.

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Sufficient control of the braking system shall be maintained to insure smooth stop motion when the variable control is returned to the stop position.

3.3.1.3.2. A variable scan speed will provide suitable viewing speed at all magnifications. Film speed is to be variable at a ratio of 1000:1 within any given range and must be smooth at all speeds. The speed range shall vary from just barely moving on the screen at 70X to the fastest at which an operator can adequately view the film. The ranges of speed must be consistent with the ranges of magnification. Smooth image movement is interpreted to mean there shall be no noticeable jerking or sporadic movement of the projected image detectable by the unaided eye.

3.3.2. Image positioning controls shall be provided which allow the operator to bring any portion of the film frame into view at the center of the projection screen. The mid-point of all the various film widths will always be positioned at the mid-point of the film projection gate. Push button controls shall be provided to automatically center the projection system over the mid-point of the film. Another push button control shall provide automatic image rotation to a reference position. The joystick motion control shall be extremely sensitive -- the film speed will not vary when the joystick is positioned at a constant deflection. The null position shall be positive and limited in range. The joystick control assembly shall be removable from the viewer to permit the operator to control the image motion at a distance up to 4 feet away from the viewer.

3.3.3. Film transport control logic shall interlock the film transport operations so that it will be impossible for an operator to damage film by improper sequencing of the film transport controls.

3.3.4. The film gate and transport system shall be so constructed to prevent any damage to the film either in the static or dynamic mode. No scratches will be evident on an unexposed developed 500 foot spool of 9.5 inch film after it has been transported through the film gate ten times.

3.3.5. The operation of the film transport should be from a single joystick type control to allow forward or reverse translation of the film using this control. The direction of deflection of the joystick will correspond directly to the motion of the image across the screen, regardless of the degree of image rotation involved.

3.3.6. The ease of loading the film will be of extreme importance in this development. Rapid, positive loading and easy access to load are manatory. The system will be fabricated to allow the operator to simply load the film spool in the transport, which is automatically positioned to the front and fully exposed when the front door is opened, and attaches the end of the film to a leader which then carries it through the projection platen and onto the take up spool. No additional operations will be required after this step and the film is now loaded for viewing. The take up spool will be a special design;

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whereby, no adjustments will be required to accommodate various film sizes. The removal of the take up spool will not be required.

3.3.7. The film aperture shall measure no less than 9 1/2" X 9 1/2" and shall hold the film flat while viewing. The entire width of 9.5 inch wide film will be projected. The platen shall be designed to accommodate 70mm to 9 1/2" film of various thicknesses. An adjustable dark slide is to be provided to accommodate various width film. On transport scanning and film slew positions, the film gate shall be designed to prevent the film from coming in contact with the platen. Adequate control shall be exercised to maintain the entire projected image automatically in sharp focus in either the scanning or static mode as described in 3.2.5.

3.3.8. A mensuration system will enable to operator to measure film distances in one millimeter increments in both the "X" and "Y" axis. Maximum "X" axis measurement (parallel to the film length) will be 40 inches and "Y" axis will be 9.5. inches.

3.4. Construction

3.4.1. Electrical -

3.4.1.1. All electrical and electronic parts will be of the heavy duty, maximum reliability type. Indicatory lamps shall be provided for each fuse holder and relay, and the fuse holder shall be marked to indicate the correct amperage.

3.4.1.2. A chassis and cabinet grounding wire shall be included in the AC line cord. The chassis grounding wire shall be connected to all major electrical sub-assemblies within the cabinet so as not to rely upon the cabinet itself as a conductor. All electrical parts shall be attached to the chassis so as to insure a positive ground (eliminating any effects from paint and anodizing).

3.4.1.3. To expedite maintenance, an electrical circuit diagram shall be permanently attached to the inside of one of the cabinet covers.

3.4.1.4. The viewer shall be designed to operate on a production line basis. Therefore, it shall feature top reliability and maintainability, even though operated by semi-trained personnel on a 16-hour, 6-day week schedule - relatively trouble free performance is mandatory. All circuits will be designed to be fail-safe, properly fused and dust covers or sealed components used when required.



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3.4.1.5. All circuitry is to be designed so that intermittent variations of up to 15% of the line voltage will not materially affect the operation of the instrument.

3.4.1.6. The xenon arc lamp shall be adequately enclosed to completely protect the operator from possible explosion of the lamp.

3.4.2. Mechanical -

3.4.2.1. The cabinet, film transport and optical elements shall be of sufficient rigidity to insure that moving the machine within a building (through elevators etc.) will not affect the optics and degrade the quality of the projected image.

3.4.2.2. The structural rigidity of the viewer shall be sufficient to insure that light taps on the control panel or other sections of the cabinet will not introduce any vibration or image jump visible on the screen, as viewed with the unaided eye.

3.4.2.3. The viewers shall be equipped with 5" diameter casters for easy relocation within an office building. In addition, leveling jacks shall be provided for permanent installation purposes.

3.4.2.4. Projections and overhanging edges which would injure operator or maintenance personnel shall be reduced or eliminated where possible. All edges and corners of the cabinet should be rounded.

3.4.2.5. Special considerations shall be given to design for ease of maintenance. Access doors, panels, or covers must be provided for easy access to parts requiring periodic access.

3.4.2.6. All operating controls shall be conveniently located within the reach of a comfortably seated operator. Controls shall be grouped by function and suitably identified. Operation of controls shall follow established conventions, such as clockwise for increase, etc.

3.4.2.7. All hardware (screws, bolts, etc.) should be of American Standard sizes with a minimum of types and sizes used. If any special tools are required for disassembly or assembly, one each shall be furnished with each machine. Sheet metal or self-tapping screws are not to be used.

3.4.2.8. All surfaces shall be of a corrosion-resistant type or are to be suitably treated for protection against corrosion. Special consideration is to be given to weld joints for corrosion resistance. Painted surfaces shall be protected with suitable undercoating before application of finish coats. The entire interior of the cabinet exposed to the light path (other than lenses and mirrors) shall be coated with a non-reflecting, black coating to the extent that no reflected light shall enter the optical system.

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3.4.2.9. Parts requiring lubrication shall be easily accessible and oil holes and grease fittings shall be provided. Wherever possible, sealed bearings of the pre-lubricated type are to be used.

3.4.2.10. If reflective optics are utilized within the system they should be mounted on three point suspension systems for ease of alignment. Care shall be taken to prevent losses of resolution due to vibration in the mirror system. The mirror mounting system shall be of sufficient tolerance to insure that no free play exists in the mirror mounts.

3.4.2.11. Thorough attention to human engineering features and ease of operation is mandatory.

3.4.2.12. The viewer, auxiliary equipment and support equipment shall be built to best commercial standards, except optical quality which shall be built to standards as specified in MIL-STD-150-A. Due consideration must be given to the requirement for operation and maintenance by semi-skilled personnel. Final acceptance tests shall be performed at the final destination as specified by the contracting officer.

3.5. Miscellaneous

3.5.1. Complete system engineering drawings shall be submitted for the contracting officer's approval prior to beginning construction of any units.

3.5.2. A kit of initial spare parts and maintenance materials shall be delivered with each viewer. Items to be included but not necessarily restricted to are:

3.5.2.1. 4 each projection lamps

3.5.2.2. 2 each platen assemblies

3.5.2.3. 5 each fuses (of each type used)

3.5.2.4. 1 can of touch-up paint

3.5.2.5. Recommended 6 month operating spare parts list

3.5.3. An operator's instruction book and a comprehensive technician's maintenance book are to be delivered with each instrument. Instruction books will be written to good commercial practice and contain a minimum of cross references.

3.5.4. Testing will be progressive throughout the development program. Periodic inspections will be performed at the contractor's plant by the contracting officer's technical representative. A preliminary acceptance test is to be performed at the contractor's plant prior to shipping. Final acceptance testing will be performed after delivery and installation of the viewer.

Installation shall consist of a complete mechanical and electrical checkout and optical alignment to insure that the viewer is operating in peak condition prior to acceptance tests.

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